FOAMED SLURRY AND BUILDING PANEL MADE THEREFROM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of U.S. Ser. No. 11/449,924 now U.S. Pat. No. 7,767,019 entitled "Gypsum Products Utilizing A Two-Repeating Unit Dispersant And A Method For Making Them", filed Jun. 9, 2006, which is a continuation-in-part of U.S. Ser. No. 11/152,418 entitled "Gypsum Products Utilizing A Two-Repeating Unit Dispersant And A Method For Making Them", filed Jun. 14, 2005, now abandoned, both herein incorporated by reference.

This application is further related to U.S. Ser. No. 11/894,029, filed concurrently herewith, entitled "A Liquid Admixture Composition" and herein incorporated by reference.

BACKGROUND OF THE INVENTION

This invention relates to a foamed gypsum slurry. More specifically, it relates to a foamed gypsum slurry that includes a defoamer to produce a distribution of foam bubbles. The gypsum slurry is useful for making building panels.

Gypsum building panels offer a high performance product for a reasonable price for finishing of building spaces. Gypsum, also known as calcium sulfate dihydrate, is heated to drive off crystalline water to produce calcium sulfate anhydrite and/or calcium sulfate hemihydrate, also known as stucco, calcined gypsum or Plaster of Paris. The building panels are made by combining stucco with water. Calcined gypsum and water are combined and an interlocking matrix of gypsum crystals is formed. After the hydration of the calcined gypsum, excess water is driven off by heating, the resulting product is a relatively strong panel, having a good surface for receiving decorative finishes such as paint or wallpaper.

Although gypsum building panels are cost effective, they are relatively heavy. The panels must be moved in small batches due to the weight. Installers who work with the panels become fatigued from lifting the panels and holding them in place to be secured. Additionally, heavy panels are costly to transport. One method of controlling the density of the product is by the addition of a soap-based foam to the liquid slurry. The stucco then sets around the foam bubbles, creating voids in the gypsum matrix. It is important to control the size of the bubbles to avoid undesirable properties in the panels. If the bubbles are too small, a large number of small bubbles are needed to effect the change in density. Where there are lots of bubbles in a confined space, the resulting gypsum matrix has a low compressive strength. Bubbles that are too large cause a decrease in strength and form unsightly blisters under the facing paper.

It has been found that if the gypsum is formed having a mixture of void sizes, it is possible to produce a building panel that is both strong and free of surface defects. Various soaps produce bubbles having different properties. Some soaps form bubbles that are very strong and stable, with little tendency to break and coalesce. For the purposes of this discussion, a stable soap is defined as one developed to maximize air entrainment and minimize usage in gypsum slurries. Other soaps are less stable, forming foam, but becoming more unstable in the presence of gypsum. A combination of soaps that form stable and unstable foams allows for control of the production of larger foam voids in the gypsum slurry. Some embodiments of this invention utilize the combination of soaps described in U.S. Pat. No. 5,643,510, herein incorporated by reference.

Reduction in the amount of water needed to produce gypsum is also desirable. Water in excess of that needed to hydrate the calcined gypsum is removed by kiln drying. Fuel costs to operate the drying kiln make it advantageous to further improve the fluidity or to reduce the amount of water necessary to form a flowable gypsum slurry.

In an attempt to reduce water usage by use of a polycarboxylate dispersant, it was found that the polycarboxylate dispersant interfered with formation of the desired bubble size distribution, and the ability to control formation of larger voids. Panel strength suffered due to the formation of very stable, very small bubbles. Addition of conventional polycarboxylate dispersants apparently changes the surface chemistry of the bubbles, making it more difficult to obtain a desirable core structure. A desirable core structure is one that is engineered to have a distribution of bubbles in the slurry or voids in the set gypsum that includes a number of large voids.

Polycarboxylate dispersants can also affect both the final set and the stiffening of the gypsum slurry. Retarders can be used that affect the stiffening only. It should therefore be clear to one skilled in the art that it is necessary to balance the amounts of water, soap, dispersants, retarders and accelerators to obtain panel products having a desirable combination of water usage, void size distribution, set time and fuel usage.

SUMMARY OF THE INVENTION

At least one of these problems is eliminated or reduced by the invention described herein. More specifically, the invention provides for improved control of the bubble size distribution in a gypsum slurry and a more desirable void distribution in building panels made therefrom. Improved control of large bubble size is obtained using a slurry comprising water, a hydraulic component comprising at least 50% calcined gypsum by weight based on the dry weight of the hydraulic component, foam, a defoamer and a polycarboxylate dispersant.

Some embodiments include mixtures or combinations of the defoamer and the dispersant that are combined prior to their addition to the slurry. The defoamer and the slurry are combined in a physical mixture in at least one embodiment of the invention. In at least one other embodiment, the defoamer is attached onto the dispersant's polymer structure. Combinations of the physical mixture and the attached defoamer are also useful.

A method of preparing a gypsum panel includes forming an aqueous soap mixture having one or more soaps and foam water in an initial concentration by weight of the one or more soaps in the foam water. Foam is pregenerated from the aqueous soap mixture. A gypsum slurry is prepared by mixing together gauging water, a hydraulic component comprising at least 50 percent calcined gypsum by weight based on the dry weight of the hydraulic component, a defoamer, and a polycarboxylate dispersant. The slurry and the pregenerated foam are combined to make a foamed gypsum core having a size distribution of voids in the core. The size distribution of the voids in the core is changed by carrying out the forming step with a second concentration different from the initial concentration and then carrying out said pregenerating, preparing, and combining steps.

Other embodiments of the foamed gypsum panel are prepared by a method including adding a polycarboxylate dispersant and a defoamer, independently, to gauging water, foam water or both. The gypsum slurry is provided having calcined gypsum and the gauging water. A foam is prepared from the foam water and one or more foaming agents, then